New Waterford Consolidated Hospital
Review of the Investigations Of Indoor Air Quality With Special Reference To Claims Of Metal Poisoning

January 23, 2004

Report Prepared for:

Department of Health
At the Request of the
Cape Breton District Health Authority
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Dr. Lesbia F. Smith has prepared this report to the Department of Health at the request of the Cape Breton District Health Authority. The opinions offered herein consider information provided to the author in the form of written reports, telephone and e-mail communications, and personal interviews with hospital representatives (on January 6, 2004). All information was taken at face value; no attempt was made to verify information independently.

Mr. Wayne Cormack, P.Eng. of DCS Consultants, Richmond Hill, Ontario, provided assistance with the interpretation of the indoor air quality reports.

This report represents the author's best judgment of the circumstances considering the information provided, taken at face value, and accepts no responsibility for its use by third parties.

The author thanks the staff and management of the New Waterford Consolidated Hospital for their willingness to provide information frankly and openly during the meetings that took place on January 6, 2004.

Lesbia F. Smith, MD

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Executive Summary

This report has been prepared for the Department of Health at the request of the Cape Breton District Health Authority in December 2003, to examine the circumstances arising out of claims of metal intoxication in staff of the New Waterford Consolidated Hospital, New Waterford, Nova Scotia. The request came from Mr. John Malcom, CEO of the Cape Breton Health Authority, following discussions with Dr. Jeff Scott, Chief Medical Officer of Health, Nova Scotia.

This review consisted of examination of documents provided by the hospital, meeting with staff, administration, and other participants in the investigations carried out, consultation with specialists in other fields such as industrial hygiene, and formulation from these an opinion on the process used to investigate staff complaints, on the results of metal urinary tests in staff, and on how to move forward on some issues.

The concerns expressed could be divided into four categories: process and participation, health and safety issues, hospital assistance and empathy with sick workers, and group health and personal health.

Responses to the workforce focused on investigation of potential exposures. Exposures were selected on the basis of the symptoms that were attributable to poor indoor air quality (headache, nausea, dizziness). Subsequently investigations focused on other substances and exposure pathways which were attributed as potential causes of the complaints (metals from construction materials, metals entrained from the outside, metals emitted from inside sources, laundry chemicals, entrained dusts, as well as materials used in the renovation).

A review of indoor air quality studies concluded that they …."appear to have covered the tests that are normally conducted during studies of this type with some minor exceptions. A study of mechanical ventilation system requirements is an important related task and is to have been completed separately. This ventilation study would presumably include a review of the locations of potential sources of airborne contaminants in relation to the location of air intakes, which was mentioned in one of the air quality reports as a potential problem. As mentioned, the reports would be improved if they provided more detailed information regarding equipment calibration; occupancy levels at the time of testing, activities at the time of testing, etc….

While there are some improvements which could be made to fill in detail of the air quality investigations, the results overall do not substantially change the interpretation that a problem existed with poor air exchange in some areas of the hospital corresponding to the areas where complaints were evident. As for metal intoxication being an explanation of symptoms experienced by some staff, an analysis of the significance of the results of tests for metals in urine, as well as the exposure analysis provides some light into this hypothesis.

An independent reviewer, Dr. Ever Nieboer, McMaster University, concluded:

> "The building materials substances for which there is more than at least one analysis with results over 1000 ppm (namely aluminium antimony and barium) there is no consistent evidence that these are sources determining the observed body fluid concentrations."
>
> "In terms of the urinary levels, I do not see any consistent elevation of concern..."
>
> "In terms of the erythrocyte data, I do not see any consistent elevation of concern..."
>
> "For the symptoms reported, there is no consistent association with the body fluid levels found..."

The concerns of the staff can be addressed in a number of ways. The hospital is currently instituting a process to ensure that if personal test are carried out, it is done with appropriate informed consent, and an understanding of the results before they are received. This will be done though information / educational sessions with technical consultants and physicians.

The hospital acknowledges that people are ill. However, there is considerable disagreement as to the attribution of their illness. The hospital has engaged the services of several consultants who are expert in air quality, toxicology and the interpretation of biological monitoring results.

Without a documented exposure at the hospital, and with normal or explainable concentrations of metals in the urine of staff tested, it is not possible to attribute unusual metal exposure from the hospital environment to those who are experiencing illness.

Staff should be encouraged to seek second clinical opinions locally regarding their diagnosis of metal toxicity, as this diagnosis and the recommended treatment appears to be creating considerable concern among sick staff off work, and among working staff, as reported in the meetings of January 6, 2004.

Facilities which can offer comprehensive assessments of non-specific symptomatology exist in the area and are covered by the provincial health plan (personal communication, Dr. Roy Fox, January 16, 2004). Additional support could be provided in the form of

information sessions with professionals expert in metal exposures, measurements, and occupational investigations.

Further biological monitoring in this workforce is not warranted and if considered, should be done under the most rigorous scientific conditions (specimen collection, *a priori* criteria for the interpretation of the results, a clinically valid algorithm for follow up) and ethical conditions (informed consent and justification of objectives). An appropriate process should be in place to ensure that the expectations of such activities agree with their scientific merit and practical limits.

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Introduction

This report has been prepared for the Department of Health at the request of the Cape Breton District Health Authority in December 2003, to examine the circumstances arising out of claims of metal intoxication in staff of the New Waterford Consolidated Hospital, New Waterford, Nova Scotia. The request came from Mr. John Malcom, CEO of the Cape Breton Health Authority, following discussions with Dr. Jeff Scott, Chief Medical Officer of Health, Nova Scotia.

The Report is presented in the form of a review of circumstances with the main objectives being an examination of the investigations and the process of the investigations carried out by the hospital following complaints of illness, with special reference to claims of metal intoxication in some staff, and an evaluation of the significance of the results of the reports.

This review consisted of examination of documents provided by the hospital, meeting with staff, administration, and other participants in the investigations carried out, consultation with specialists in other fields such as industrial hygiene, and formulation from these an opinion on the process used to investigate staff complaints, on the results of metal urinary tests in staff, and on how to move forward on some issues.

Background

The current situation has been in progress for about two years. In 2001, the hospital underwent a series of planned renovations on the third and second floors lasting nearly one year for the third, and about 6 weeks for the second. Complaints of symptoms arose during and after the renovations that led to an indoor air quality investigation. Several staff never fully recovered from their symptoms and sought assistance from local medical practitioners. Several people now find themselves ill and unable to return to work. A local practitioner has written letters to the hospital medical representative (Dr. Mike

Ryan) indicating that up to 11 people are suffering from metal intoxication attributed to renovation associated in-hospital acute exposures to metals superimposed on chronic exposure from external ambient sources. Some of the purported ambient sources are the coal burning energy generation plant several kilometers away, and the hospital laundry.

The hospital has responded to these claims by carrying out a series of investigations to determine if there is any evidence of exposure to metals and other pollutants, and to examine any condition which can explain the symptoms experienced by some of the workers. In general, the investigations have focused on exposure assessment. A chronology of these investigations is provided below.

2001 - 2002	The hospital undergoes renovations in the area of the second floor of the New Waterford Consolidated Hospital. Renovations are completed in August 2001. The first complaints arise in the fall of 2002 from staff in a suite of offices on the second floor. On December 9, 2002, the Manager of facilities takes an "air sample" (a "grab sample")[1] and "nothing unusual is found". Additional air quality studies are sought and carried out in February 2003.
February 2003	Symptoms referent to poor indoor air quality are brought forward and the hospital contracts Atlantic Indoor Air Audit Company to carry out an indoor air quality investigation. A report of the investigation is presented.[2] This report's findings indicated that air conditioned air was delivered only to the corridors, not to the individual offices. There was evidence of poor air entry into the office suite where complaints had arisen manifest by elevated carbon dioxide level above 1000 ppm in a rising pattern morning to afternoon. There was no evidence of volatile organic compounds or of fungal contamination. Recommendations were made to correct the situation.
April 2003	Following the February Report, Mersereau Occupational Hygiene Consulting carried out an additional study of indoor air quality.[3] The Mersereau Report concluded that fluctuation in temperature and humidity, as well as lack of fresh air could provide an explanation for the symptoms being experienced, namely, *headache, dizziness and nausea.* Recommendations included improving the ventilation system (short-term and long tem solutions suggested), locating the

[1] Personal communication, Mr. John Malcom, January 2004).

[2] Atlantic Indoor Air Audit Co. Air Quality Report, New Waterford Community Hospital, Dr._____ offices and surgery, February 2003.

[3] Mersereau Occupational Hygiene Consulting, Report of New Waterford Hospital, Oral and Maxillofacial Unit, Air Quality Investigations, Interim Report, April 30, 2003

	mechanical ventilation away from potential pollution sources outside, and compliance with health and safety requirement in the development of the new ventilation design, and removal of debris from above ceiling tile spaces.
May 2003	Mersereau Occupational Hygiene Consulting provides a report of metal in air in the second floor of the New Waterford Consolidated Hospital. "The results indicate that all metals (sic. tested) were not present in levels that exceeded the acceptable indoor concentrations."[4]
May 2003	The hospital examines tap water quality. A report provided by Environmental Services Laboratory Inc. of Sydney, NS, indicates that one metal parameter is slightly above guidelines: manganese (.063, guideline is 0.05 mg/l), and the water is acidic.[5]
May 23, 2003	Mersereau Occupational Hygiene Consulting conducts a walkthrough survey to assess indoor air quality in the x-ray and laboratory areas of the New Waterford Hospital to determine spatial and temporal occurrence of symptoms and identify potential sources of contamination of the indoor air quality. Carbon monoxide, carbon dioxide and temperature and humidity were tracked in each of two work areas. A review of chemicals used in the hospital was also done. The investigator conducted a walk through and interviews with occupants. A number of recommendations were made to improve air quality, lighting, and humidity levels; to investigate outdoor infiltration of pollutants; and to institute breaks away from the area to ensure sufficient recovery for the staff. No specific explanation for the symptoms was established other than the general air quality and potentially, some ergonomic issues (lighting, computer display characteristics, and rest breaks away from the area).
July 2003	Mersereau Occupational Hygiene Consulting provides a report on Water and Building Materials Metal Analysis.[6] Building materials are examined (samples taken June 26, 2003): "…building materials were analyzed to determine if renovations done in the Spring 2002, could have released metals into the workplace air."[7]

[4] Mersereau Occupational Hygiene Consulting. Metal Air Analysis. Cape Breton Healthcare Complex. New Waterford Consolidated Hospital., 2nd Floor Area. New Waterford. NS. May 2003.
[5] Laboratory Report from Environmental Services Laboratory Inc. of Sydney, NS.
[6] Mersereau Occupational Hygiene Consulting. Water and Building Materials Metal Analysis. Cape Breton Health Care Complex. New Waterford Consolidated Hospital. New Waterford. NS. July 2003.
[6] ibid

The report indicates that results of analysis for metals in 16 samples of building materials indicate concentrations of "toxic" metals (lead, mercury, arsenic, nickel) less than 1%; one sample of insulation of metal pipe showed an aluminum concentration in excess of 1%, but it is not considered a "toxic metal". The benchmark of 1% is a "rule of thumb". (sic. The concentrations of metals are much lower than 1%).

The report indicates that drinking water met all Canadian Drinking Water Guidelines.

The Report concludes, "the construction activity was unlikely to have been the cause of the health concerns in the area with respect to toxic metal content."

N.B. **A separate commentary on all of the air quality investigations is presented in *Appendix 1* (DCS Consultants review of Indoor Air Quality Investigations, January 2004).**

July 2003

The administration provides a detail of the construction that took place in the New Waterford Consolidated Hospital. The report indicates that construction included moving of walls, introduction of new walls made out of "dry wall", but did not include the moving of air vents, or any work to the ventilation system.

August 2003

Evert Nieboer, PhD, professor Department of Biochemistry, McMaster University, provides a report on his interpretation of the results of metal analysis of the urine of New Waterford Consolidated Hospital staff.

Dr. Nieboer reviews each of the results, compares the results from two laboratories, makes recommendations for sample rejection, and retesting follow up. Dr. Nieboer also provides information relevant to usual sources of metals in urine from day to day exposures in such cases that were above the reference intervals for the laboratories that carried out the analyses.

August 2003

Mersereau Occupational Hygiene Consulting provides a report on the laundry lint emissions and ventilation system dust sampling for metals. Bulk lint samples and wet wipe 10 cm square swab samples were taken from the inside of the ventilations system. The report concludes: *Metal content was low in the samples collected.*

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[7] New Waterford Consolidated Hospital Construction Report., prepared by Richy Brennick and Sister Marie Kelly. July 2003

[8] Mersereau Occupational Hygiene Consulting. Laundry and Ventilation System Sampling Interim report. New Waterford Consolidated Hospital. New Waterford, NS.

October 2003	ADI Ltd. carried out more sampling for metals in the air of the New Waterford Consolidated Hospital in the fall to examine if there are any changes that could be attributable to seasonal influences. The accompanying report from ADI Ltd. on the metal concentrations in air tested on October 14, 15, and 16, 2003 in 15 locations throughout the hospital as a follow up to earlier reports indicates: *"All toxic metals are present in concentrations less than the regulatory limit and the guideline value"*. Samples were taken from breathing level. Most metals were below detectable limits, and only chromium was detectable but well below indoor air quality guidelines.
December 2003	Dr. Evert Nieboer provides *Final Report: Review of Cape Breton District Health Authority New Waterford Consolidated Hospital Test Results - Urine and Blood Specimens, December 1, 2003.* Dr. Nieboer provides comments on red cell metal values upper limits gleaned from scientific literature, and presents a caveat, and I infer that these limits can be exceeded in certain conditions such as seafood consumption for arsenic and smoking for cadmium. He also offers opinions regarding the metal concentrations in urine and provides an integrated opinion: *"My conclusion is that the most prevalent complains reported are those associated with inadequate ventilation."*

Site Visit, January 6, 2004

On Tuesday January 6, 2004, the author of this report visited the New Waterford Hospital on the invitation of its CEO, Mr. John Malcom. Mr. Malcom provided a brief orientation that supplemented the written material provided prior to the site visit. A walk-through of the areas that had undergone renovation and the areas outside led by Glen Cameron, Manager, Environmental Engineering, consisted the first introduction to the site. This introduction was accompanied by a description of the areas affected by the renovations of 2001-2002. This walk through was intended to give life to the written reports provided, and not to perform an air quality assessment.

Meetings from 9:15 am to 2:30 pm were pre-arranged by the hospital. These meetings provided an opportunity to hear directly from the people involved what questions and concerns they had, and to hear their perspectives. The following groups and people were present

- Helen Mersereau, Occupational Hygienist, Mersereau Consulting

- New Waterford Hospital Joint Health and Safety Committee[7]
- Milton Cooke, Occupational Hygienist, Safety Officer, Nova Scotia Department of Labour
- Union Leadership
- Senior Management
- Dr. Charles Badenhorst, Medical Officer of Health
- Ms. Peggy Forward, Hospital Staff Health

What were the main issues concerns?

The concerns expressed could be divided into four categories: process and participation, health and safety issues, hospital assistance and empathy with sick workers, and group health and personal health. All of the specific issues and concerns expressed were taken at face value and enumerated below.

Process and Participation

1. *Hospital testing for indoor air and sampling of materials for analysis of metal content was not carried out with the union representatives or health and safety committee present.*
2. *The hospital administration did not do enough to engage the staff (occupational health and safety) in making sure that the renovation was done properly. In particular, that effort was not made to protect people from hazardous dusts.*
3. *Hospital did not consult on the use of a competent contractor sensitive to occupational health and safety concerns.*
4. *An overall plan of the biologic testing and interpretation was not worked out before biological testing was done on hospital personnel. Any further testing, environmental or otherwise, should be done with a plan and a priori objectives.*
5. *Results of urine tests were not reported back expeditiously.*

Health and safety protection

6. *No masks were provided to non-construction workers.*
    a. *Was there coal ash dust?*

[7]New Waterford Hospital Health and Safety Committee

1.	Jeanette Ewing	CAW
2.	Eric Courtney	Management
3.	Mary Crawley	CUPE 2431
4.	Eric Smith	CAW 4603
5.	Judy McGibbon	CAW 4600
6.	Carol Ann Tighe	Non management, non union
7.	Patricia McDonald	Management Nursing
8.	Glen Cameron	Management - Environmental Engineering
9.	Tom McNeil	Manager, OHS
10.	Peggy Forward	Staff Health

b. Was there asbestos?

Hospital assistance and empathy

7. *What is the hospital doing to ensure that the concerns of the workforce are being addressed?*
8. *There is no acknowledgement that people are ill.*

Group health and personal health

9. *The staff have no confidence in the interpretation of the results of urinary metals. What do the levels mean?*
10. *Are the symptoms caused by metal exposures?*

Specific concerns and questions

1. *People are sick; the unions are very concerned. The hospital administration has not been supportive of the people who are sick;*
2. *Is the illness directly due to working in the hospital? Staff need answers.*
3. *Is there any asbestos in the building and workers were not warned?*
4. *"Construction workers and staff were not adequately protected". During the hospital renovations, plastic barriers were not maintained and thus escaped dust could have provided exposure of workers to metals in the dust. No masks were provided to non-construction workers.*
5. *Isolated urine measurements without other assessments such as dietary, smoking etc. are difficult to interpret, so a plan should have been in place to account for these.*
6. *Further testing without objectives should consider ethical consequences.*
7. *Staff who were tested are very concerned that their doctor has told them that they are suffering from metal poisoning.*
8. *If they are suffering from metal poisoning (sic... as a result of their hospital exposure), the hospital should be prepared to finance their treatment.*
9. *What does Dr. Nieboer's assessment mean? Why are red cell values for metals so different from urine values? Why are the two laboratories in disagreement? What does it mean to consider the creatinine level?*
10. *Will I get sick from having metal in my urine even if I am not sick now?*
11. *Have I exposed my child because I was here during my pregnancy? " My child has high metal levels (aluminum) in the urine."*

Responses by the Hospital

Responses to the workforce focused on investigation of potential exposures. Exposures were selected on the basis of the symptoms that were attributable to poor indoor air quality (headache, nausea, dizziness). Subsequently investigations focused on other substances and exposure pathways which were attributed as potential causes of the complaints (metals from construction materials, metals entrained from the outside, metals emitted from inside sources, laundry chemicals, entrained dusts, as well as materials used in the renovation).

The hospital administration and facilities management have stated that the building does not have any asbestos on site.

Studies of the internal environment of the hospital have shown that exposures to toxic substances such as VOCs, metals in the lint from the laundry, and metals from the ventilation system *could not have occurred as their concentrations were well within guidelines, or in some cases, so low as to be below detection limit of the laboratory.* In the future, the hospital administration has confirmed that all sampling will be carried out with appropriate participation of union representatives so as to demonstrate transparency in the methods and respond to concerns immediately.

An overall plan of the biologic testing and interpretation was not worked out before the testing was done on hospital personnel. Any further testing, environmental or otherwise, should be done with a plan and *a priori* objectives.

The concerns of the workforce can be addressed in a number of ways. The hospital is currently instituting a process to ensure that when personal tests are carried out, they are done with appropriate informed consent, and an understanding of the results before they are received. This will be done through information / educational sessions with technical consultants and physicians (personal Communication, Mr. J. Malcom).

The hospital acknowledges that people are ill. However, there is considerable disagreement as to *the attribution of their illness to metal exposures at the hospital.* The hospital has engaged the services of several consultants who are expert in air quality, toxicology and the interpretation of biological monitoring results to clarify this position.

In addition, staff will be recommended to seek assistance from medical resources in the community capable of reviewing their current symptoms and treatment. The hospital will facilitate obtaining a second medical opinion on the illnesses being experienced by their staff from an appropriate clinical consultant. Such consultation is available within Nova Scotia.

Evaluation of the Air Quality Investigation

DCS consultants, Richmond Hill, Ontario, evaluated the reports of each of the investigations referent to air quality at he New Waterford Consolidated Hospital. (Full text in Appendix 1). They conclude:

"*In summary, the indoor air quality studies reviewed above appear to have covered the tests that are normally conducted during studies of this type with some minor exceptions (review of adjacent areas, for example). A study of mechanical ventilation system requirements is an important related task and is to have been completed separately. This ventilation study would presumably include a review of the locations of potential sources of airborne contaminants in relation to the location of air intakes, which was mentioned in one of the air quality reports as a potential problem. As mentioned, the reports would be improved if they provided more detailed information regarding equipment calibration, occupancy levels at the time of testing, activities at the time of testing, etc. Floor plans showing the study areas (and adjacent areas) would also be useful addition to these reports.*"

While there are some improvements which could be made to fill in detail of the air quality investigations, the results overall do not substantially change the interpretation that a problem existed with indoor air quality and that it could explain the symptoms originally presenting. As for metal intoxication being an explanation of symptoms experienced by some staff, an analysis of the significance of the results of tests for metals in urine, as well as the exposure analysis provides some light into this hypothesis.

Significance of Results of Tests for Metals in the Urine

The Report by Dr. Evert Nieboer provides one framework for the interpretation of the significance of the individual values obtained for the hospital staff that provided urine for metal analysis. The framework examines the laboratory ranges, the ranges in the scientific literature associated with disease, and considers the testing done in the hospital to make inferences about a source of exposure to metals above what might be expected from living in New Waterford, NS.

Background exposure to metals in New Waterford may be expected to be a bit higher that in other areas where coal is not used for energy generation or for heating in the home. I was informed that many homes use coal for heating and that this could be considered an additional potential source of background exposure for local residents.

This background exposure is experienced potentially by the entire community, and therefore would be evident only when group averages (i.e. levels in hospital employees and levels in a group from the community NOT hospital employees) are compared with controls without the same background exposure (i.e. another community).

Without conducting such a study, it would not be scientifically sound to state that there is no exposure. What one can say is that the levels of metals found are within the expected normal range, or are explainable by testing parameters (see below).

1. Were the samples collected under conditions that precluded contamination of the sample?

Some samples reported in the course of my meetings with staff indicate that the sampling procedures may have been flawed and introduced external contamination.

2. Was there a complementary assessment of diet, smoking status, presence of any chronic disease especially kidney insufficiency, diabetes, anemia, iron deficiency, hypothyroidism; ingestion of medications such as contraceptive pills, other hormones; pregnancy, etc?

Metals in urine can vary considerably depending on diet, metabolic activity, kidney function, medications, smoking status and concurrent illness. If results are normal, there is no cause for concern. If they are elevated, other concurrent circumstances should be examined at the level of the individual.

3. What does a metal level in the urine mean with regard to occupational exposure that occurred many months before?

Unless the exposure was continuous, an analysis done months after one purported exposure (in addition to background) would not be useful to support or disconfirm the exposure. With ongoing exposure, results need to be interpreted in the light of #2 above.

4. With the caveats on interpretation of the results of metals in urine, are the results obtained associated with any short-term or long-term consequences?

The results of the urine metal analysis reviewed are not associated with short-term or long-term consequences, especially considering the caveats around specimen collection and other personal characteristics.

The results of the 11 subjects claiming metal intoxication are in the "normal" range, albeit, described for some as "high normal", nevertheless, normal. Aluminum high levels are not explained and are unlikely to be significant. Symptoms which are reported to occur are transient and have no proven long term consequences.

Aluminum is ubiquitous, and thus presents a contamination problem of significant proportions when obtaining urine samples. If aluminum in urine is to be used as a measure of non-food exposure (i.e. airborne dust presumably inhaled and or coughed up and swallowed, in this case), then it is absolutely necessary to collect the urine specimen without risk of external contamination, and in conjunction with a dietary assessment to exclude dietary contributions which are generally the greatest contributor to urinary and

blood aluminum. Many foods contain a lot of absorbable aluminum (teas, soft drinks, chewing gum, processed cheese) as do antacids, and antiperspirants.

If the measurement is taken under the most careful circumstances, aluminum in urine does reflect total exposure, but is not prognostic of disease. Blood aluminum would be expected to be elevated in the presence of kidney insufficiency. Without knowledge of concurrent health status in an individual or a group of individuals, the value obtained from analysis of a single void urine specimen or blood level in a single circumstance is almost valueless.

5. Can the person's presenting symptoms be explained by any concurrent illness? Can the initial symptoms be explained by the acknowledged poor indoor air quality in designated areas of the hospital?

The symptoms experienced initially and reported in the surveys done by the air quality investigation consultant are known to be associated with poor indoor air quality and with a variety of ergonomic deficiencies in work areas. The symptoms are not expected to continue once corrections are made, and should have no long-term consequences.

Conclusions

Exposure Assessment

The hospital has effectively evaluated the potential sources of metal exposure within its walls to hospital staff. Namely, it has examined its ventilation system, its indoor air, its drinking water, and the materials used during the renovation. This effectively includes all exposure sources (except the food consumption and personal habits of the staff). Improvements can be made on the air quality investigation approach, methodology, and reporting. Notwithstanding, exposure sources for metals in the hospital are not supported and such improvements are not likely to contradict the overall conclusions of the reports. Any claim to metal intoxication must be made with a careful assessment of sources of metal exposure other than the hospital, and careful clinical confirmation.

This cannot be done without the examination of each individual for these exposure sources, followed by medically accepted clinical tests to confirm a diagnosis of metal toxicity. While it is possible that some staff may be experiencing metal toxicity for whatever reason, it is not possible given the information generated by the investigations reported, to have developed from exposures sustained at the hospital.

One way to assist staff experiencing clinical manifestations of metal toxicity, is to carry out a hazard assessment of the total environment of each person attributing his or her symptoms to metal toxicity to determine significant sources, and undertake a complete health status assessment to document any contributing medical condition. Such investigations can try to determine the actual source of the metal exposure, determine which metal is at issue, and provide an intervention. In most cases, the appropriate

intervention would be to stop the exposure even if it were demonstrated that levels were above normal.

Dr. Nieboer's Final report confirms that there is unlikely to be significant exposure to metals, precluding a diagnosis of metal intoxication resulting from hospital exposures, or relevance of symptoms to metal toxicity.

> "The building materials substances for which there is more than at least one analysis with results over 1000 ppm (namely aluminium antimony and barium) there is no consistent evidence that these are sources determining the observed body fluid concentrations."
>
> "In terms of the urinary levels, I do not see any consistent elevation of concern..."
>
> "In terms of the erythrocyte data, I do not see any consistent elevation of concern..."
>
> "For the symptoms reported, there is no consistent association with the body fluid levels found..."

Although staff are sick, and metal toxicity attributable to hospital exposure is implausible, then other causes of symptoms should be sought. The examination of the individual for a concurrent illness is essential in determining the potential cause of symptoms. To attribute symptoms to metal toxicity there must be clinical tests that confirm the person's metal status as above normal. When urinary metal levels are normal, or explainable by a variety of personal factors if they deviate from the norm, as they appear to be in the staff of this hospital, then it is uncertain as to what additional tests would be indicated clinically.

Clinical considerations

Some patients have undergone diagnostic chelation challenge[9] and are undergoing treatment with chelating agents[10] (personal communication, Dr. Ben Boucher, January 11, 2004). Informants at the meetings report that everyone is confused by the fact that some staff continue to report illness, and have been diagnosed as having symptoms attributable to metal intoxication, and are undergoing chelation treatment. A significant source of ambient exposure to metals has not been found within the hospital.

Without a documented exposure at the hospital, and with normal or explainable concentrations of metals in the urine of staff tested, it is not possible to attribute unusual metal exposure from the hospital environment to those who are experiencing illness.

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[9] Letter to Dr. Mike Ryan dated January 6, 2004 from Dr. Ben Boucher provided by Dr. Ben Boucher to Dr. Lesbia Smith

[10] Letter to Dr. Mike Ryan dated January 8, 2004 from Dr. Ben Boucher provided by Dr. Ben Boucher to Dr. Lesbia Smith.

Staff should be encouraged to seek second clinical opinions locally regarding their diagnosis of metal toxicity, as this diagnosis and the recommended treatment appears to be creating considerable concern among sick staff off work, and among working staff, as reported in the meetings of January 6, 2004. Facilities which can offer comprehensive assessments of non-specific symptomatology exist in the area and are covered by the provincial health plan (personal communication, Dr. Roy Fox, January 16, 2004). Additional support could be provided in the form of information sessions with professionals expert in metal exposures, measurements, and occupational investigations.

Further biological monitoring in this workforce is not warranted and if considered, should be done under the most rigorous scientific conditions (specimen collection, *a priori* criteria for the interpretation of the results, a clinically valid algorithm for follow up) and ethical conditions (informed consent and justification of objectives). An appropriate process should be in place to ensure that the expectations of such activities agree with their scientific merit and practical limits.